
# Critical Care Therapy and Respiratory Care Section

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| Category: | Clinical |
| Section: | Aerosol Therapy |
| Title: | Delivery of Aerosolized Medications via Metered Dose Inhaler or Small Volume to Intubated Mechanically Ventilated Patients |
| Policy #: | 03 |
| Revised: | 09/00 |

## 1.0. DESCRIPTION

1.1 Definition: Aerosolization of medications to mechanically ventilated patients is achieved through the use of a metered dose inhaler (MDI) with a chamber-style spacer or via a small volume nebulizer (SVN) placed within the inspiratory limb of the ventilator circuit. When appropriately used, the spacer serves as a reservoir for aerosolized particles prior to delivery of the particles into the tracheobronchial tree during the inspiratory phase of a mechanical breath. Delivery of medication via SVN to ventilated patients may be less effective. It has been reported that aerosol administration to intubated pediatric patients is even more limited in its effectiveness due to the very small amount of drug (1-6%) that actually reaches the lungs.

1.2 Indications: The use of the MDI and spacer or SVN is indicated for mechanically ventilated patients requiring therapy for:

1.2.1 Relief of bronchospasm through the use of beta-adrenergic or antimuscarinic agents

1.2.2 Relief of inflammation through delivery of corticosteroids to the airways

1.2.3 Prophylaxis of mediator-induced bronchoconstriction

1.2.4 Mucokinesis

1.2.5 Antimicrobial therapy

1.3 Contraindications: Medicinal aerosol therapy is contraindicated when there is known hypersensitivity or the history of an allergic reaction to a specific pharmacologic agent. Refer to the package insert or the Physicians Desk Reference for product-specific contraindications.

1.4 Complications

1.4.1 Improper use of the MDI or malfunction of the device may result in underdosing or overdosing.

1.4.2 The propellant in the MDI (Freon) may cause cardiotoxic effects.

1.4.3 Additional complications may result due to the pharmacokinetics of specific agents. Refer to the package insert or the Physicians Desk Reference for specific information.

1.5 Precautions

1.5.1 Due to the small percentage of aerosolized particles which may reach the airways of intubated patients, it is recommended that the standard dose for MDI therapy be **doubled** for intubated patients.

1.5.2 Patients receiving aerosolized medications should be monitored throughout the therapy for side effects.

1.5.3 Large sputum loads in the airways, especially in the artificial airway, may prevent the delivery of the medication to the patient's airways. Patients should be assessed for the need for suctioning prior to drug delivery.

1.5.4 The efficacy of MDI therapy is dependent upon proper technique. See 3.0. PROCEDURE.

1.5.5 Aerosolized particles liberated from dry powder inhalers may clump when exposed to high humidity.

1.5.6 The efficacy of therapy may be dependent upon the sequence of administration of bronchodilators. It may be optimal to deliver antimuscarinics prior to beta-adrenergic agents.

1.5.7 Placing a SVN in-line with a ventilator will alter the flow characteristics of the ventilator-delivered breath. The tidal volume (TV) must be monitored closely. Adjustments to the TV or to the pressure setting in pressure-controlled mode must be made accordingly. In some circumstances, it may be advantageous to increase the rise time to temper the effects of the increased flow such that turbulent flow is minimized. The addition of flow for powering the nebulizer to the circuit also renders the ventilator less sensitive to the patient and may require an increase in the sensitivity for the duration of the treatment. These effects are especially important when ventilating pediatric patients.

1.5.8 A chamber-style spacer increases the compressible volume of the ventilator circuit when left in-line. When using the spacer with a pediatric circuit, remove the spacer between treatments.

1.6 Adverse Reactions and Interventions: Discontinue therapy immediately if acute changes in vital signs are observed during drug delivery. Monitor the patient for a return of vital signs to pre-treatment levels. Report these findings to the physician.

## 2.0 EQUIPMENT AND MATERIALS

2.1 Metered dose inhaler and spacer OR

2.2 Small volume nebulizer with compressed gas source

2.3 Stethoscope

2.4 Cardiorespiratory monitor

## 3.0 PROCEDURE

3.1 Suction the patient if indicated.

3.2 Assess the patient's breath sounds, peak inspiratory pressure (PIP), exhaled tidal volume, vital signs, and SpO2.

**MDI administration:**

3.3 Position the spacer within the inspiratory limb of the ventilator circuit.

3.4 Warm the MDI to body temperature.

3.5 Shake the MDI vigorously, and place it within the spacer receptacle.

3.6 Actuate the MDI at end-exhalation and apply a two to three second breath hold, if tolerated by the patient. This is performed by turning and holding the inspiratory hold button.

3.7 Perform subsequent actuations at one-minute intervals.

3.8 Monitor the patient throughout the treatment for tolerance of the therapy.

3.9 Return the ventilator to pretreatment settings.

3.10 Reassess the patient for the status of breath sounds, vital signs, and ventilatory mechanics (see 3.2 above).

**SVN administration:**

3.11 Prepare the medication and nebulizer as per the manufacturer's recommendation for total solution volume.

3.12 Place expiratory filters in-line when needed to prevent flow transducer clogging, i.e., pentamidine or amphotericin.

3.13 Position the nebulizer within the circuit in the inspiratory limb approximately 18 inches from the patient airway (three sections of corrugated tubing), and bypass the humidifier. Bypassing the humidification system is necessary to minimize the tendency of water vapor to increase particle size. Power the nebulizer with compressed gas at a liter flow specified by the nebulizer manufacturer.

3.14 Adjust the ventilator when necessary to maintain appropriate flow and volume dynamics:

3.14.1 For pediatric patients whose set TV is less than 250 ml, decrease the set TV to account for the additional flow through the nebulizer. The delivered TV should remain relatively unchanged after the ventilator adjustment with minimal increase in PIP.

3.14.2 For patients on pressure-controlled modes, note the exhaled TV, and make adjustments to the PIP as necessary to maintain the exhaled TV at pre-treatment levels.

3.14.3 When it is necessary to minimize turbulent flow, increase the rise time (Siemens 300) to the upper range (i.e., 8-9%). This may be especially beneficial when pediatric airways are employed or patients have a significant amount of airway resistance.

3.14.4 When flows exceeding 4 liters/min are used to power the nebulizer, it may be necessary to increase the sensitivity of the ventilator to account for the increase in bias flow. With the Siemens 300, the flow sensing knob may be placed in the red zone for this purpose.

3.15 Monitor the patient throughout the treatment for tolerance of the therapy.

3.16 Tap the sides of the nebulizer as the treatment progresses to minimize dead volume. The treatment is complete when there is no longer any aerosol being produced.

3.17 Return the ventilator to pretreatment settings.

3.18 Reassess the patient for the status of breath sounds, vital signs, and ventilatory mechanics (see 3.2 above).

3.19 Remove the expiratory filters from the circuit.

3.20 Rinse the SVN with sterile water and leave it to air dry. Store in an aseptic plastic bag.

**4.0 POST PROCEDURE**: Continue to monitor and assess the effects of therapy in the post treatment period. Beneficial effects may not be noted immediately in all patients, but they may be evident in the period of time shortly after drug administration.

**5.0 CHARTING:** Document the outcome and effects of therapy on the "Notes" side of the ventilator flowsheet.

**6.0 REFERENCES**


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6.2 Hess D. Inhaled bronchodilators during mechanical ventilation: delivery techniques, evaluation of response, and cost-effectiveness. Respir Care 1994;39(2):105-122.

6.3 AARC Clinical Practice Guideline "Selection of Aerosol Delivery Device." Respir Care 1992;37:891-897.

6.4 Fardy HC, Silverman M. Aerosol therapy in the newborn. Tufts University School of Medicine and Floating Hospital for Children Reports On: Neonatal Respiratory Diseases 1996:6(2).

6.5 Generic Respiratory Care Policy and Procedure Manual: Aerosol Delivery Through Mechanical Ventilator.

6.6 Gross NJ, Jenne JW, Hess D. Bronchodilator therapy. In: Tobin MJ, ed. Principles and practice of mechanical ventilation. McGraw-Hill, 1994.

SIGNATURE:_____ DATE:_____
Assistant Section Chief, CCTRCS, CCMD

SIGNATURE:_____ DATE:_____
Section Chief, CCTRCS CCMD

SIGNATURE:_____ DATE:_____
Medical Director, CCTRCS CCMD

(Orig. 3/9/95)
(Rev. 12/96, 9/00)